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PRELIMINARY REPORT

ON THE INTERRELATION OF FIRE AND INSECTS IN YELLOW PINE

(Tubb's Hill Burn)

by

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INTRODUCTION

Following forest fires of the ground or surface type, there is often a marked increase in the number of trees which are attacked by barkbeetles. This is a condition which is especially true of fires occurring in yellow pine and white pine stands. The most popular explanation which is offered for this interrelationship is that the insects attacking the fire-injured trees develop in abnormal numbers and subsequently attack other trees. Though this solution to the problem seems to be an apparently logical one, it is subject to considerable question.

There are many factors to be considered in analyzing the relationship which fires bear towards subsequent barkbeetle infestations. To know more of these many factors, as well as their relationship to the economic aspects of this problem, it is necessary that fundamental studies of the interrelationship of fires and insects be instituted when favorable opportunities occur.

Forest fires, particularly those occurring in white pine and yellow pine stands, have been credited with causing a temporary increase of barkbeetle damage, and also heavy losses to merchantable timber caused by various species of wood-boring insects. The most serious losses to the white and yellow pine in this region result from the attacks of the mountain pine beetle and the western pine beetle. These two species of barkbeetles are practically always present in the pine forests of the West, but attract the most attention only when in an epidemic form. In recent years it has been frequently observed that normal barkbeetle infestations are intensified by forest fires and often develop into serious epidemics.

"Light" or ground fires greatly increase the number of trees susceptible to barkbeetle attack. Many of these trees that are only slightly injured by the fire and would possibly recover, are selected and killed by the attacks of the barkbeetles, and the heavily fire-damaged trees are attacked by various species of Cerambycids and Buprestids. Many questions in regard to the attraction value of certain classes of fire-injured trees, their ultimate recovery if not attacked by barkbeetles, and the rise and fall of infestations on burned areas, still remain unanswered, and only through intensive study of these problems can the reasons be found. An exceptional opportunity to study the interrelation of fire and insects in yellow pine in this locality was made possible by the occurrence of a ground fire on the south slope of Tubb's Hill, Coeur d'Alene, Idaho.

TUBB'S HILL BURN

On September 22, 1926, a fire of incendiary origin was discovered on the south slope of Tubb's Hill (see map). The city reservoir being situated on the east slope and the Coeur d'Alene sawmill at the base of the hill on the north slope, immediate action was taken to fight the fire and it was placed under control in a few hours' time, after burning over 30 acres of an almost pure yellow pine stand. The area burned consists of about one-half of the southern slope of the hill. The fire originated in an old abandoned building near the shore of the lake, at an elevation of 2,124 feet, and spread to an elevation of 2,400 feet before being placed under control. As this part of the hill had been free from fire for a number of years, considerable undergrowth was present, consisting of buck-brush, ocean spray, ninebark, serviceberry, chokecherry, and syringa. The duff that had accumulated on the slope consisted mostly of yellow pine needles and dead grass and was littered with pine cones and twigs. The surface of the area is very irregular, owing to numerous large granite boulders and small ravines. These irregularities along with the steepness of the slope caused a fire of varying degrees of severity from a light ground fire where the stand was open to a heavy crown fire where the growth was small and dense in the small ravines. All of the undergrowth on the area was destroyed, as well as a large per cent of the yellow pine reproduction. A few of the larger yellow pines were burned through at the base and partly consumed after falling.

The burned area was examined by the writer on October 25, 1926, and a number of the larger fire-scorched yellow pine were found to have

been recently attacked by the mountain pine beetle. This is a very unusual occurrence, both from the large number of Dendroctonus monticolae beetles attacking and the attack occurring so late in the season. From the years 1917 to 1927 this area (locally known as Tubb's Hill) had been used by the Coeur d'Alene Forest Insect Field Station as one of five check areas for intensive study of the annual insect losses caused by the western pine beetle Ips oregoni, and wood-borers, no trees ever having been found on the area prior to the fire that were killed by the mountain pine beetle.

CLASSIFICATION OF FIRE DAMAGE

The classification of the various degrees of fire injury as used by the Palo Alto, California, station, which would seem to justify standardization, has been followed in classifying the degrees of burn on the Tubb's Hill fire.

1. Classes of Fire Injury

I. No visible fire injury
II. Up to 25% of crown defoliated
III. 25 to 50% " " "
IV. 50 to 75% " " "
V. 75 to 100% " " " but with terminal buds and cambium green
VI. 100% defoliation, cambium severely injured, terminal buds killed.

Some of the trees placed in Classes V and VI at this time will undoubtedly need to be interchanged when further study is made of the burn during September and October, 1929.

2. Types of Burn

1. No fire injury. All trees in Class I. No trees of this class were found within the boundary of the burn.

2. Light ground fire; practically no standing trees killed; damage represented by Classes II and III comprising 54.2% of the stand.

3. Medium fire damage represented by Classes IV and V, comprising 28% of the stand.

4. Severe crown fire, represented by Class VI, comprising 17.8% of the stand.

An additional classification of fire damage based on the per cent of root collar injury has also been used for all of the damaged trees.

1. Classes of Fire Injury to Root Collar

I. No visible fire injury
II. Up to 25% of root collar damaged
III. 25 to 50% " " " "
IV. 50 to 75% " " " "
V. 75 to 100% " " " "
VI. 100% root collar completely damaged

The degrees of injury to root collar on the heavily insect-attacked trees were determined by removing a small strip of bark at the surface of the ground around the entire bole and measuring the circumference and the amount of fire injury. The classes of root collar injury on all other trees were based on the outward appearance, the per cent of injury judged by the visible area of the root collar scorched.

LOSS ESTIMATE OBTAINED BY A 100 PER CENT SURVEY

The estimate of the loss on the burn was obtained by the writer by making a 100 per cent survey between the dates October 22 and November 23, 1928. The object of this survey being to determine the amount and degrees of fire injury and the number of trees attacked by barkbeetles after the fire. As a basis for future study of insect losses all the trees on the burn from 6 inches D.B.H. and over were marked with a small blaze and a

numbered metal tag. A data sheet was made out for each tree, recording the D.B.H., height, volume board feet, crown class, degree of fire injury based on both injury to the crown and root collar, and any evidence of insect attack. An increment core was also taken from each tree for information on rate of growth. The small trees from 6 to 10 inches D.B.H. were marked and recorded to determine the class of fire injury offering the most suitable host for the various species of secondary barkbeetles and wood-borers.

ACREAGE OF FIRE BY TYPES OF BURN

Owing to the small acreage burned and the various types being so intermingled, no attempt was made to estimate the acreage of each type.

Total acreage of burn - 30 acres
Stand of timber: yellow pine - 98.4%
" " " Douglas fir - 1.6%
Average stand bd.ft. per acre - 2985.3
Total volume bd.ft. for entire burn - 89,560

Estimated volume in bd.ft. according to classes of fire injury:

	No. of Trees	%	Total Vol.	Av.Vol.	% of Vol.
Class I	0	0	0	0	0
Class II	397	37.8	53060	133	59.2
Class III	173	16.4	15150	86	17.0
Class IV	111	10.5	6390	57	7.0
Class V	185	17.5	9660	52	10.8
Class VI	187	17.8	5300	28	6.0
Total	1053	100.0	89560		100.0

A large per cent of the mature yellow pine in the more open stand, comprising Classes II and III, were injured mainly by a ground fire. Many of these trees were heavily infected by mistletoe resulting in large witch brooms, particularly on the lower crown. In some instances these witch brooms with their accumulation of pine needles caught fire from the ground flames and caused various degrees of injury to the lower crowns. These trees were also subject to root collar injury of varying degrees.

Trees from 12 to 14 inches D.B.H. in Classes IV and V were more concentrated in and at the heads of the small draws or ravines and suffered various degrees of crown injury, as well as injury to root collar. Trees in Class VI were mostly young and thrifty, growing in dense stands at the heads of the small ravines, the greatest loss occurring in diameters under 12 inches. The loss from trees burned down by the fire at the base was small; only five were recorded at the time of the preliminary examination.

INSECT LOSSES WITHIN THE BURNED AREA

Owing to the lateness of the season when the fire occurred September 22, thoughts of barkbeetle flights and attack would hardly be considered, but the 100% survey of the burn showed that seventeen of the larger fire-scorched yellow pine had been heavily attacked by the mountain pine beetle and at the time of examination eggs and young larvae were present.

Yellow Pine Heavily Attacked by the Mountain Pine Beetle Classified by Foliage Injury and Compared with Classification of Root Collar Injury.

Tree No.	Vol. Bd.Ft.	Classified by Foliage Injury	Classified by Root Collar Injury
8	870	Class II	Class VI
9	220	" II	" IV
62	60	" VI	" III
63	180	" IV	" IV
71	360	" V	" IV
126	1640	" III	" VI
364	310	" II	" VI
458	220	" II	" V
552	360	" VI	" IV
559	1470	" II	" II
663	620	" VI	" V
664	--	" VI	" VI
665	30	" VI	" VI
705	480	" II	" IV
925	590	" IV	" III
1048	190	" III	" VI
1053	--	" IV	" V

Classified by Injury to Foliage				Classified by Injury to Root Collar			
No. Trees	Class of Injury	Vol. Bd.Ft.	Av.Vol. Bd.Ft.	No. Trees	Class of Injury	Vol. Bd.Ft.	Av.Vol. Bd.Ft.
0	I	0	0	0	I	0	0
6	II	3570	595	1	II	1470	1470
2	III	1830	915	2	III	650	325
3	IV	770	257	5	IV	1600	320
1	V	360	360	3	V	840	280
5	VI	1070	214	6	VI	3040	608

A comparison of these two classifications shows that there are 6 trees under Class II, Injury to Foliage, as compared with 1 tree under Class II, Injury to Root Collar. While 5 of these trees show no effects of defoliation by the fire, the root collars were severely scorched from the accumulation of duff at the base of the trees, and have been distributed among the other classes of root collar injury. This change of classification also changes the average volume in board feet for the different classes.

Fifty-nine other fire-damaged yellow pine with a total volume of 20,410 bd.ft. were also found attacked by Dendroctonus monticolae at the time the trees were marked. These attacks were all considered as pitched out or ineffective, though later examinations may show that some of them may be successful, owing to the weakened condition of the trees. Prior to this fire no extensive losses by the mountain pine beetle in yellow pine in this vicinity have been recorded at this station. An occasional weakened tree had been found with an associate attack of D. monticolae and Ips sp. The western pine beetle has been considered as the primary barkbeetle in destroying yellow pine in this region since the establishment of the Coeur d'Alene Station in 1917.

Insect Losses in Yellow Pine on Tubb's Hill Prior to the 1925 Fire

Year	Yellow Pine: No. Trees Top Killed	Primary Insect Responsible for Loss	Volume Board Feet	Yellow Pine: No. Trees Killed Entirely	Primary Insect Responsible for Loss	Volume Board Feet	Yellow Pine: No. Trees Killed Entirely	Secondary Insect Responsible for Loss	Volume Board Feet
1917	3	Ips. sp.	390	2	D.brevicomis	610	—	—	—
1918	8	" "	1020	9	" "	2300	1	Buprestid	480
1919	6	" "	780	7	" "	1810	3	"	180
1920	—	—	—	—	—	—	—	—	—
1921	—	—	—	2	D.brevicomis	210	—	—	—
1922	—	—	—	4	" "	90	93	Ips oregoni	No vol. under 12"
1923	1	Ips oregoni	10	5	" "	230	24	" "	30 (27 under 12")
1924	—	—	—	3	" "	260	1	" "	30
1925	—	—	—	—	—	—	7	" "	110 (5 under 12")
1926	—	—	—	2	" "	60	—	—	—
1927	—	—	—	3	" "	1210	—	—	—
1928	—	—	—	3	" "	1720	5	Ips oregoni	—
Total	18	Ips oregoni	2200	40	D.brevicomis	8500	134		830
		Average	122		Average	212		Average	6.2

SOURCE OF INFESTATION BY MOUNTAIN PINE BEETLE

No known mountain pine beetle infestation in yellow pine has occurred in this vicinity within the past 12 years, so it would seem that the source of the present infestation on the Tubb's Hill burn had come from infested white pine stands, this species apparently being the preferred host of D. monticolae in this region. Mountain pine beetle infestations have been in progress for many years past on the Coeur d'Alene National Forest. The nearest known infestation in white pine is 26 miles distant from the Tubb's Hill burn. The principal flight and attack period of D. monticolae in the white pine stands in the Coeur d'Alene National Forest extends from the last week in June until the first week in August. The attacking period of the partial second generation emerging from trees attacked early in July is practically over by the middle of September. The thoughts of a flight of the mountain pine beetle occurring after September 22, leaving its preferred host and flying 26 miles to attack fire-scorched yellow pine, seem very improbable. The only other theory of their presence on the burn is that the beetles came from white pine logs transported from logging operations on the Coeur d'Alene National Forest. A short time previous to the fire a large consignment of white pine logs had been transported by rail from the Coeur d'Alene Forest. These logs were unloaded from flat cars on the long pier in Coeur d'Alene Lake and placed in booms until needed. One of these booms of logs was stored near the west short of Tubb's Hill and it is believed that the D.

monticolae beetles that attacked the yellow pine on the burn may have emerged from the upper sides of these logs. Three yellow pine attacked by D. brevicomis were found on the burn but the attacks were prior to the fire.

Owing to the lateness of the season when the fire occurred no wood-borer work was present when the trees were marked, but it is possible that a large per cent of the trees in Class V and Class VI will be attacked by secondary barkbeetles and wood-borers during the season of 1929.

Respectfully Submitted,

S/ Henry J. Rust

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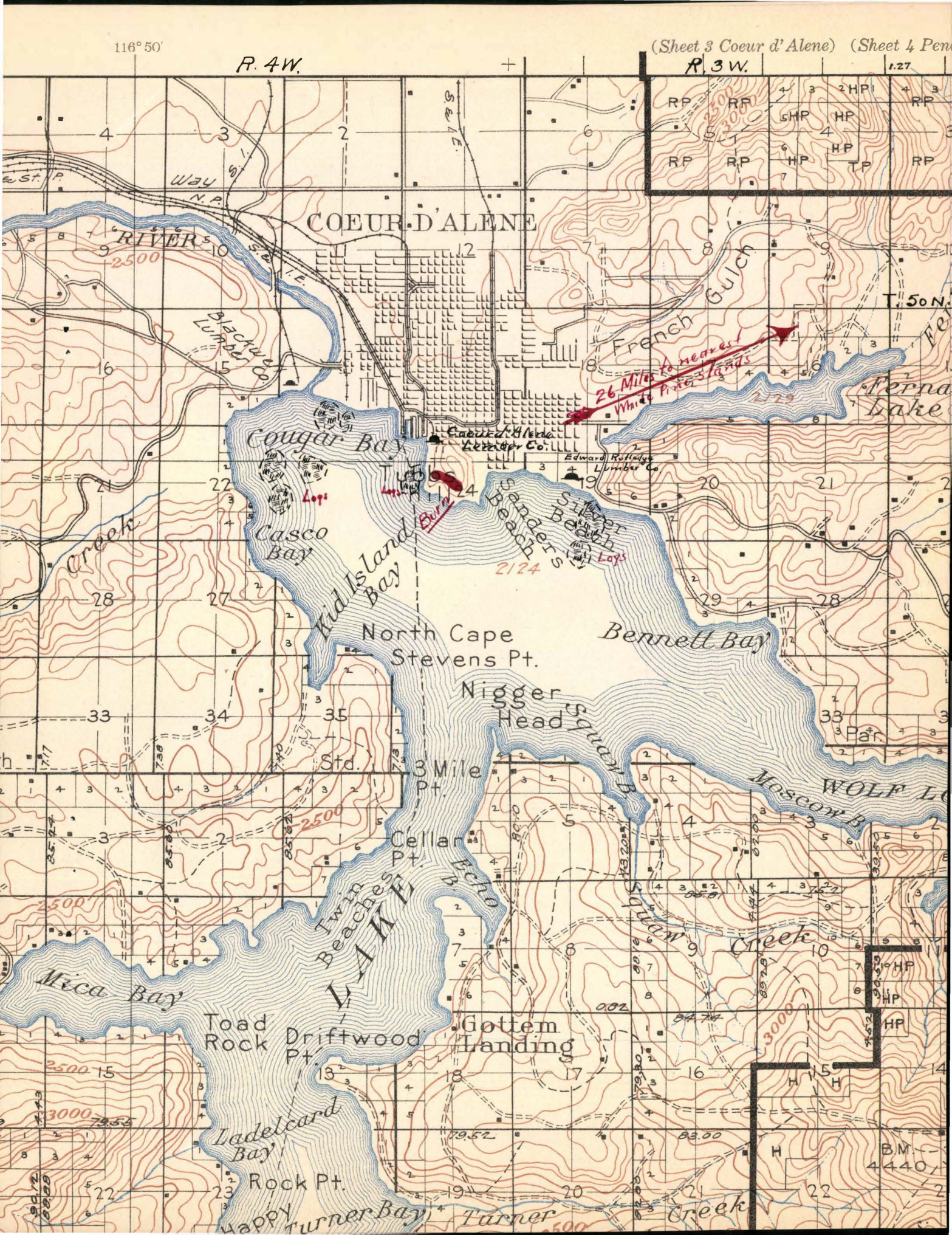
Senior Scientific Aid.

July 15, 1929


116° 50'
(Sheet 3 Coeur d'Alene)
(Sheet 4 Pen
R. 4W.
R. 3W.
COEUR D'ALENE
RIVER
Way
N.P.
S.P.
Blackwell Lumber Co.
French Gulch
T. 50 N.
26 Miles to nearest White Pine Stands
Fernan Lake
Cougar Bay
Coeur d'Alene Lumber Co.
Edward Rutledge Lumber Co.
Logs
Burn
Casco Creek
Casco Bay
Kid Island Bay
Sanders Beach
Silver Beach
2124
North Cape
Stevens Pt.
Bennett Bay
Nigger Head
Squaw B.
Moscow B.
WOLF L
Par.
Std.
3 Mile Pt.
Cellar Pt.
Twin Beaches
Echo B.
LAKE
Squaw Creek
Mica Bay
Toad Rock
Driftwood Pt.
Gottem Landing
Ladelcard Bay
Rock Pt.
Happy Turner Bay
Turner Creek
B.M. 4440
RP
HP
TP
H
2500
3000